Problem 85

When nonmetric units were used in the United Kingdom, a unit of mass called the pound-mass (lbm) was used, where 1 lbm = 0.4539 kg. (a) If there is an uncertainty of 0.0001 kg in the pound-mass unit, what is its percent uncertainty? (b) Based on that percent uncertainty, what mass in pound-mass has an uncertainty of 1 kg when converted to kilograms?

Solution

Part (a)

Use the formula for percent uncertainty and plug in the numbers.

$$\begin{aligned}\text{Percent Uncertainty} &= \frac{\delta A}{A} \times 100\% \\ &= \frac{0.0001 \text{ kg}}{0.4539 \text{ kg}} \times 100\% \\ &\approx 0.02\%\end{aligned}$$

Part (b)

Start with the same formula, using the result of part (a) and the given uncertainty of 1 kg. Let the mass in pound-mass be x.

$$\text{Percent Uncertainty} = \frac{\delta A}{A} \times 100\%$$

$$\frac{0.0001 \text{ kg}}{0.4539 \text{ kg}} \times 100\% = \frac{1 \text{ kg}}{x \times \frac{0.4539 \text{ kg}}{1 \text{ lbm}}} \times 100\%$$

$$\frac{0.0001}{0.4539} = \frac{1 \text{ lbm}}{0.4539x}$$

Solve for x.

$$x = \frac{1 \text{ lbm}}{0.0001} = 10{,}000 \text{ lbm}$$